

[19] 中华人民共和国国家知识产权局

[51] Int. Cl⁷

H04M 1/02



[12] 发明专利申请公开说明书

[21] 申请号 02149884.9

[43] 公开日 2003 年 4 月 16 日

[11] 公开号 CN 1411253A

[22] 申请日 2002.9.28 [21] 申请号 02149884.9

[30] 优先权

[32] 2001. 9. 28 [33] JP [31] 303959/2001

[32] 2002. 6. 28 [33] JP [31] 189488/2002

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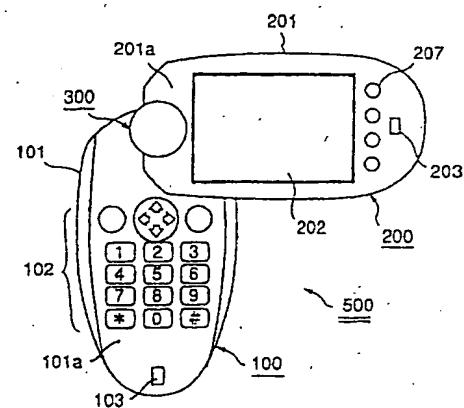
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权利要求书 3 页 说明书 20 页 附图 14 页

[54] 发明名称 可折叠便携式信息终端

[57] 摘要

一种可折叠便携式信息终端包括一个在其一侧上具有一个显示单元的上部单元，一个在其一侧上具有操作按键的下部单元，和一个连接上部单元和下部单元允许上部单元相对于下部单元的纵向开启、关闭和自由旋转的可移动连接机构。根据上部单元和下部单元的位置关系来改变其方向根据上部单元位置而变化的显示单元的显示模式。



1 S S N 1 0 0 8 - 4 2 7 4

开与关闭方向上独立地旋转上部和下部两个单元 200 和 100。这个双轴铰接结构可以提供第二旋转轴，用作包括轴部件和支架构造的开关旋转轴。这种结构也包括在本发明的双轴铰接件概念中。

1.3) 电路

5 接着，将描述根据本发明的便携式电话机的电路。

如图 6 所示，根据本发明的便携式电话机被构造以包括天线 104、射频电路 105、调制解调器 106、基带处理电路 107、编译码电路 108、控制单元 109、麦克风 103、操作按键 102、告警装置 110 和检测上部单元位置（相对于下部单元的位置）的三个磁传感器 111a、111b 和 111c。这些功能部件安装在下部单元 100 中。检测上部单元位置（相对于下部单元的位置）的装置并不限制于磁传感器（霍尔元件）。例如，也可以使用弹簧开关或已知的机械开关。

10 控制单元 109 包括一个旋转角度检测器 112，根据每个磁传感器 111 的输出确定上部单元 200 的旋转角度；一个开关检测器 113，检测开关状态，包括前后状态；一个显示控制器 114，控制显示内容的方向以反映旋转角度检测器 112 和开关检测器 113 的输出；呼叫达到和终止控制器 115，可以执行对应于上部单元的开关和移动操作的呼叫到达控制操作；和告警控制器 116，控制对应于上部单元的开关和移动操作的呼叫到达通知。

15 射频单元 105 包括未图示的接收电路、发射电路和频率合成器。操作按键 102 包括发射按键、用于数字/假名/汉字/字母的转换按键、电源开关按键、用于 20 光标操作的十字按键和结束按键。

而且，该实施例的便携式电话机被构造以包括一个扬声器 203、对应于磁传感器 111a 和 111b 的磁铁 204a、对应于磁传感器 111c 的磁铁 204c、作为主屏幕的显示单元（液晶显示器 LCD）202、触摸板装置 205、第二显示单元 206 和内置在显示单元 202 表面的第二操作按键 207。这些功能选择安装在上部单元上。

25 扬声器 203 用于电话受话器，并用作告警装置 110。

构成电路的这些独立电路部件可以是常规部件，将省略对它们的详细描述。

在具有使用双轴铰接件 300 连接的两个单元的根据本实施例的便携式电话机 500 中，上部单元 200 可以通过围绕第二旋转轴 302 旋转而相对于下部单元开启和关闭，并可以相对于下部单元 100 围绕第一旋转轴 301 旋转。因此，尽管上部单元 200 的前后表面被限制在与第二旋转轴 302 平行的方向上，上部单

元可以围绕第一旋转轴位置旋转到下部单元一个表面上的任意位置上。进一步，也可以将上边向下转到同样位置。换句话说，下部单元 100 和上部单元 200 可以根据需要采用不同的相对位置。在一个预定停止位置上，可以保持与水平旋转轴限制装置和棘轮装置的相对位置。

5 1. 4) 相对位置检测

磁传感器 111a、111b 和 111c 和磁铁 204 互相协作来检测下部单元 100 和上部单元 200 之间的相对位置。将详细描述磁传感器 111 和磁铁 204 的安装位置。

如图 7A 所示，三个霍尔元件（磁传感器）111 安装在下部单元 100 的内部，传感器的传感侧面向操作面一侧。两个霍尔元件 111a 和 111b 安装在围绕水平旋转轴 301 的预定半径的圆周上，所在的两条半径线相对于下部单元的长轴分别形成 45° 从而在附图中形成 90° 的圆心角。第三个霍尔元件 111c 安装在下部单元前端偏向一侧的位置上。

另一方面，如图 7B 所示，半圆形和在附图厚度方向上磁化的磁体 204a 在下部单元 200 内围绕第一旋转轴 301 沿着预定半径的圆周安装。而且，磁体 204b 安装在上部单元前端对应于霍尔元件 111c 的位置上。

磁传感器 111 可以安装在上部单元 200 上，磁体 204 可以安装在下部单元 100 上。构成一对的一个磁传感器和磁体的一个基本上安装在上部单元上，另一个安装在下部单元上。并不必须使用一个半圆形磁体，也可以将分离的磁体安装在霍尔元件 111a 和 111b 的对应位置上。

如图 8 所示，Lo1 表示在两个单元折叠并且显示面向外的情况下磁铁 204a 的位置，Lo4 表示磁铁 204b 的位置。在这种状态下，各个霍尔单元 111a、111b 和 111c 产生输出，从而可以根据旋转角度检测器 112 和开关检测器 113 的输出来确定上部单元的当前状态（位置）。

Lo2 表示磁铁 204a 在附图中以顺时针方向旋转 90° 时的位置。在这种情况下，仅霍尔元件 111b 产生输出，从而能够确定上部单元的状态（位置）。Lo3 表示磁铁 204a 在附图中以顺时针方向进一步旋转 90° 时的位置（普通通信位置）。在这种情况下，没有从任何一个霍尔元件获得输出。因此，可以确定上部单元的状态（位置）。

当两个单元以显示面向内而折叠时，磁铁 204a 的位置也变成 Lo1（磁场的方向变成与图 8 相反）。然而，因为磁铁 204 的位置变成并不与霍尔元件 111c

一致的 104'，可以确定两个单元处于显示面向内的折叠状态。当霍尔元件还检测磁铁的磁场方向，可以在不提供霍尔元件 111c 和磁铁 204b 的情况下检测各种位置，并可以检测位置上的一个精确差别。

1.5) 上部和下部单元的位置

5 在根据本实施例的便携式电话机中，上部单元和下部单元可以采用各种所需要的相对位置（相对状态）。尤其在图 9A-9D 所示的停止位置上，可以保持相对位置。

如图 9A 所示，便携式电话机在常规情况下折叠，形状很小并便于携带。而且，显示面向内因而被保护。第二显示部 206 提供最小的信息显示。

10 图 9B 图示从图 9A 的状态竖起并伸展上部单元 200 的状态（普通通信状态）。在这种状态下，可以以类似于常规便携式电话机的方式执行显示器的确认、各种操作和通信。

15 接着，图 9C 图示上部单元 200 从图 9B 所示的状态，例如沿着与下部单元 100 的操作表面 101a 的平行面在顺时针方向上旋转大约 90° 的状态。此时，显示部被水平定位。图 9c 状态还在上部单元从图 9D 的折叠状态滑出并在逆时针方向旋转时获得。

20 当上部单元和下部单元图 9c 所示的位置关系中时，通过上述位置检测装置来检测这种位置关系，所述位置检测装置导致显示控制器 114 将显示单元 202 上所显示显示内容转换成水平方向的显示（显示内容的左右方向与显示单元的长边方向相匹配）。

在图 9c 所示的状态中，因为水平方向的显示，易于确认大量的字符信息和观看一个在水平方向上延长的图像的显示。

25 图 10A 图示显示单元 202 在水平方向内容信息显示在水平方向屏幕上状态中的一个显示例子（一幅图像）。如图 10A 所示，水平方向上长内容的整个显示图像被显示在水平方向屏幕上。

根据本实施例的设备，垂直方向的内容可以在该设备在如图 9B 和 9D 所示的显示部垂直方向位置上时被显示，并可以通过预定操作或设置来显示水平方向图像的中部内容和附加信息。

30 图 10B 图示水平延长内容信息被显示在图 9B 和 9D 所示的垂直方向显示屏上时显示单元 202 的另一个显示例子。

在垂直方向显示状态中，内容左侧和右侧被如图 10B 所示切除。当水平延长内容信息显示在垂直方向屏幕上时，可以在上下边缘显示内容附加信息（与内容有关的字幕信息）或其它功能（邮件功能等）（不显示内容的部分或图 10B 的垂直方向屏幕的阴影区域）。这样一个垂直方向显示模式允许功能改变，例如

5 通过关闭声音输出和显示字幕，或者允许同时使用多个功能，例如在接收垂直方向内容信息数据流时执行另一个功能。

1.6) 方向控制

在本实施例中，因为两个单元采用上述各种位置，通过诸如方向指示按键（光标按键）的一个按键的包括方向的操作来匹配对应于上述各种位置中每一位置的显示方向。

如图 11A 所示，考虑到上述单元 200 从关闭状态竖起和伸展的情况（普通通信位置），在上部单元 200 的显示单元 202 上显示菜单或内容。在这种情况下，下部单元 100 的操作按键 102 中的“方向键”用于移动光标或选择一个菜单项。当对应于一个方向 D1-D4 的“方向键”被按下时，在显示屏上执行在一个相应方向 D1'-D4' 中的操作。

随后，当显示单元 202 从图 11A 的状态旋转 90° 时，改变操作按键 102（方向键）的移动方向，从而匹配图 11B 所示的上述单元 200 的显示单元 202 的上部、下部、左部和右部。换句话说，当对应于一个方向 D1-D4 的“方向键”被按下时，在水平方向显示屏上执行与上述方向不同（但与“方向键”的操作方向一致）的一个相应方向 D1'' 至 D4'' 中的处理。以这种方式，根据显示单元垂直和水平方向之间的切换来适当地改变由一个操作键指示的操作。

如上所述，根据该实施例的便携式电话机，可以通过将显示单元在开启状态下旋转到一个指定方向来观看显示器，并执行一个所需要的操作。尽管在附图中未图示，与上述描述相反，也可以将上部单元 200 从图 9B 所示的普通通信位置（标准打开状态）在显示器平面方向上逆时针方向旋转大约 90 度。在这种状态下，上部单元 200 和下部单元 100 也变成大约相同平面内的近似正交的状态，并且显示单元变成相对于操作面的上下方向水平定位。

在这种情况下，上部单元和下部单元的这样一种位置关系可以通过上述位置检测装置来检测，致使显示控制器 114 将在显示单元 202 上显示的显示内容 30 转换成水平方向的显示，即显示内容的左右方向匹配显示单元的长边方向即与

图 9C 所示方向相反的方向。而且，如前所述适当地改变预定操作键所指示的处理。

在根据该实施例的便携式电话机中，还可以将上部和下部单元设置成关闭状态以便使显示单元向外，与在关闭时显示单元向内的普通状态相反。如图 9D 5 所示，上部单元 200 与下部单元 100 折叠，上部单元 200 的显示屏向外。例如，当上部单元 200 从便携式电话机如图 9B 所示的开启状态旋转半圈时，可以如图 9D 10 所示以相反方向关闭上部单元和下部单元，显示面向外。在这种情况下，便携式电话机变得很小并便于携带。同时，可以可视地确认在折叠状态中的显示内容。而且，因为第二操作部 207 向外，可以响应于显示内容使用第二操作部 207 15 执行所需要的操作。

如图 9D 所示的这样一种折叠状态通过上述上部单元位置检测装置检测，导致显示单元上的显示内容颠倒。在这种情况下，通过诸如方向指示键（光标键）的一个按键的包括方向的操作匹配显示方向。通过这种结构，用户可以在通常 15 折叠状态中执行所需操作时阅读所显示的内容，而不改变用户手持便携式电话机的方式。

1.7) 操作

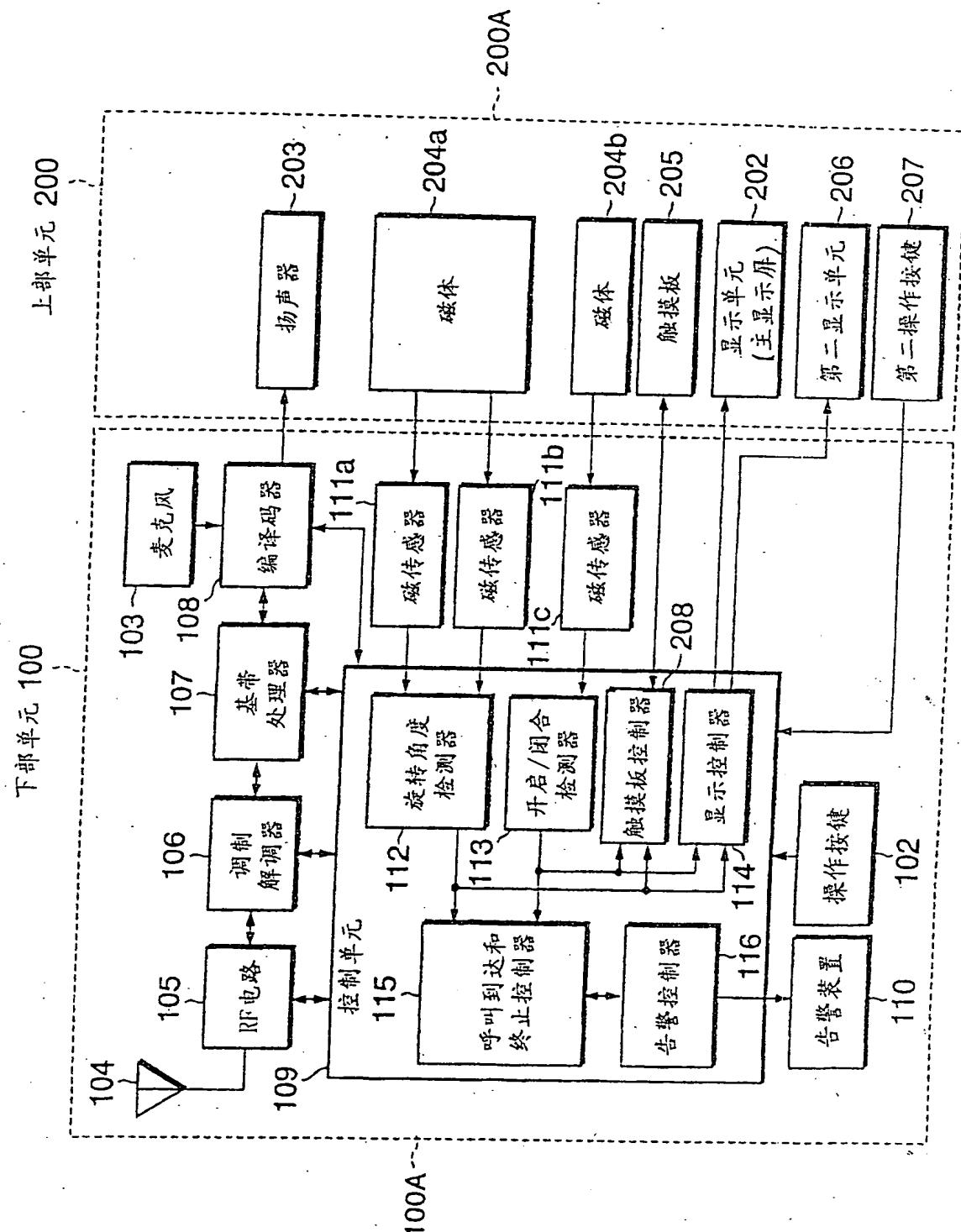
将描述按照该实施例的便携式电话机的操作。

首先，将解释发送和接收一个话音信号的便携式电话机的操作。天线 104 20 从基站接收一个无线电信号，并发射一个无线电信号。由天线 104 接收的无线电信号被输出给射频电路 105 的接收电路。接收电路选择由频率合成器指示的一个频率的信号，并确定所选择的信号是否包括将一个来话呼叫通知该终端的信号（待机接收）。

当接收单元已经检测到将来话呼叫通知该终端的信号时，接收电路将来话 25 呼叫通知控制单元 109。控制单元 109 从接收电路接收有到该终端的一个来话呼叫的通知，并驱动诸如蜂鸣器、振动器和/或发光二极管的告警装置 110 以通过声音、振动和/或发光通知用户有一个到该终端的来话呼叫。

用户可以将便携式电话机设置到一种模式，以便当它检测到上部单元和下部单元在普通通信位置上打开时呼叫到达和终止控制器 115 自动将操作设置为摘机状态以连接电话线路。在这种设置中，从呼叫始发端发出的接收信号被输出 30 经射频电路 105 输出给调制解调器 106。同时，呼叫到达和终止控制器 115

6



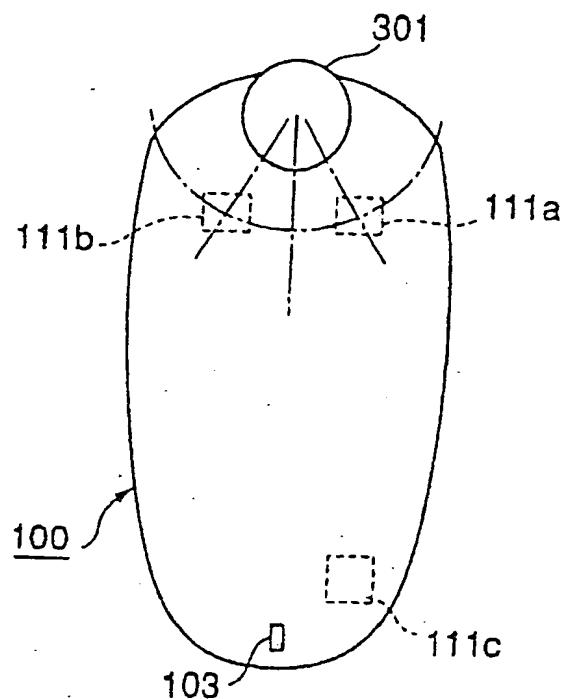


图 7A

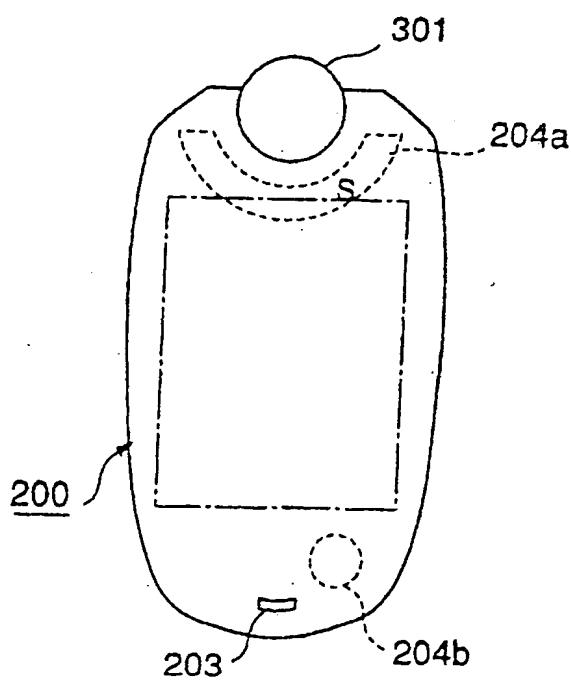


图 7B

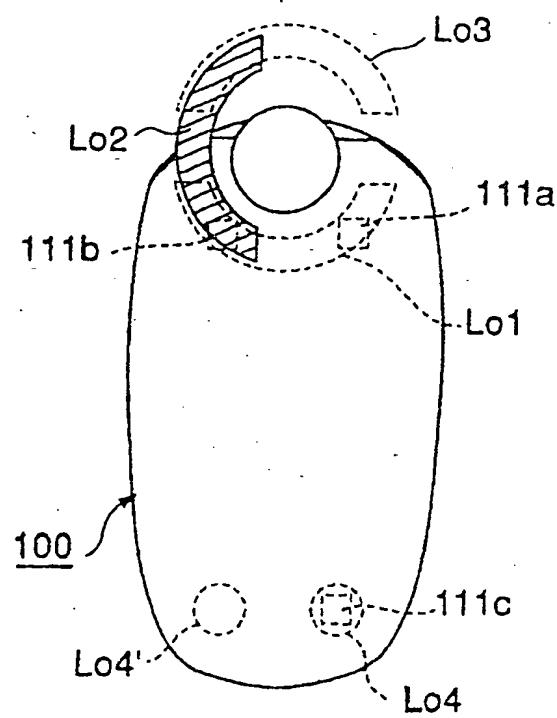


图 8

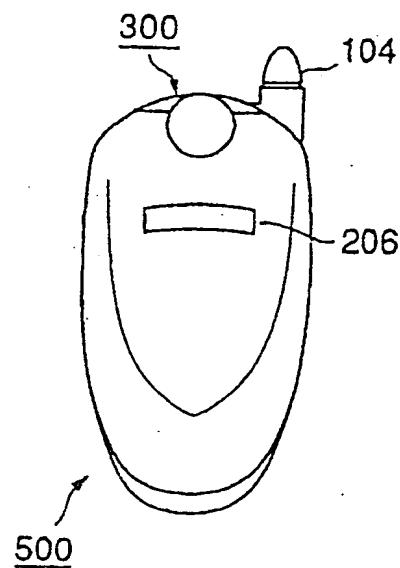


图 9A

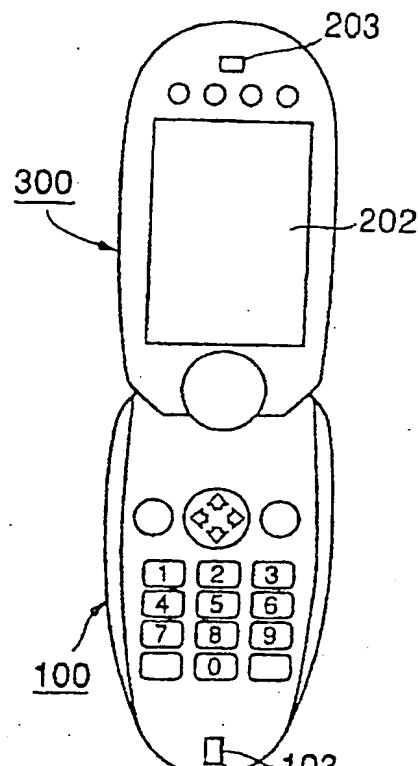


图 9B

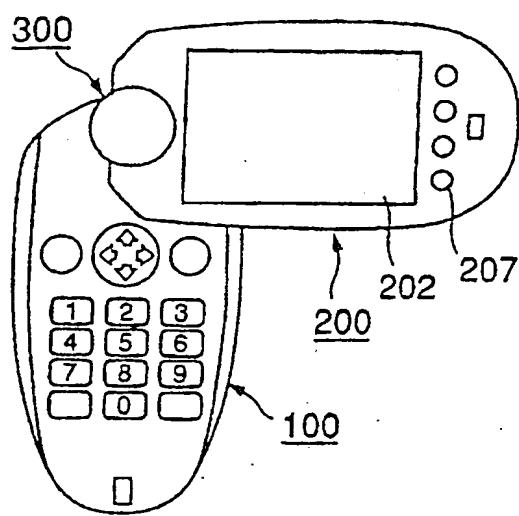


图 9C

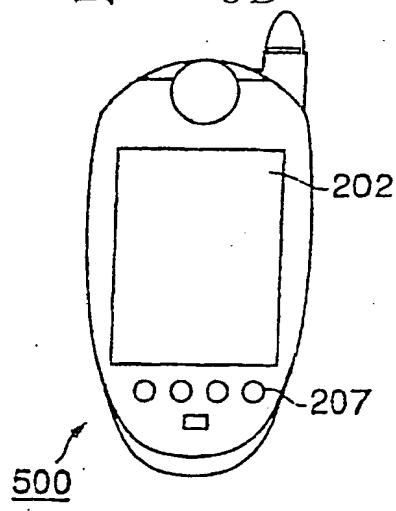


图 9D

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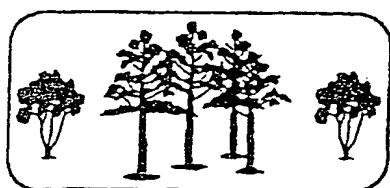


图 10A

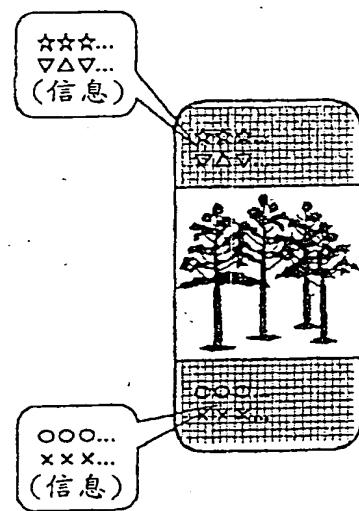


图 10B

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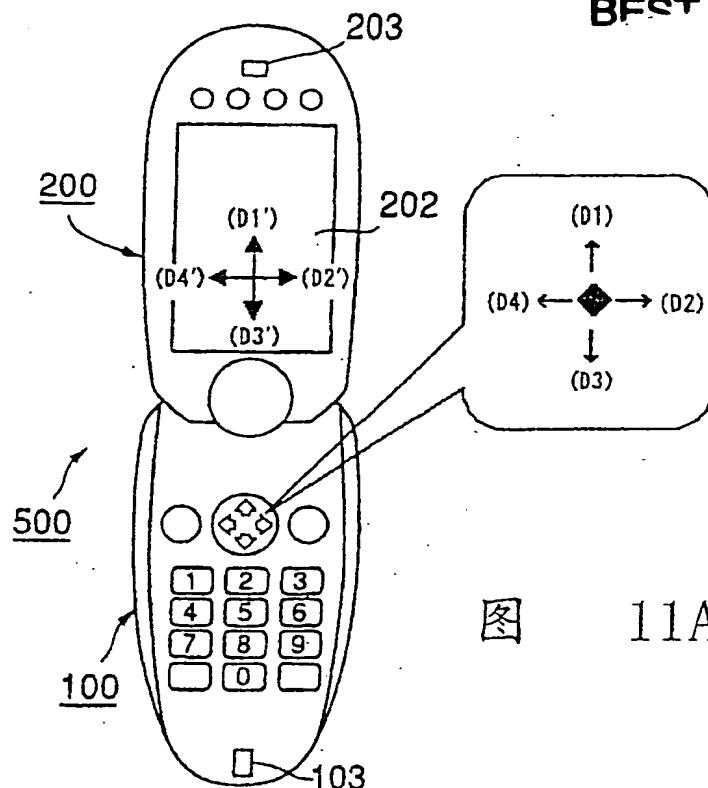


图 11A

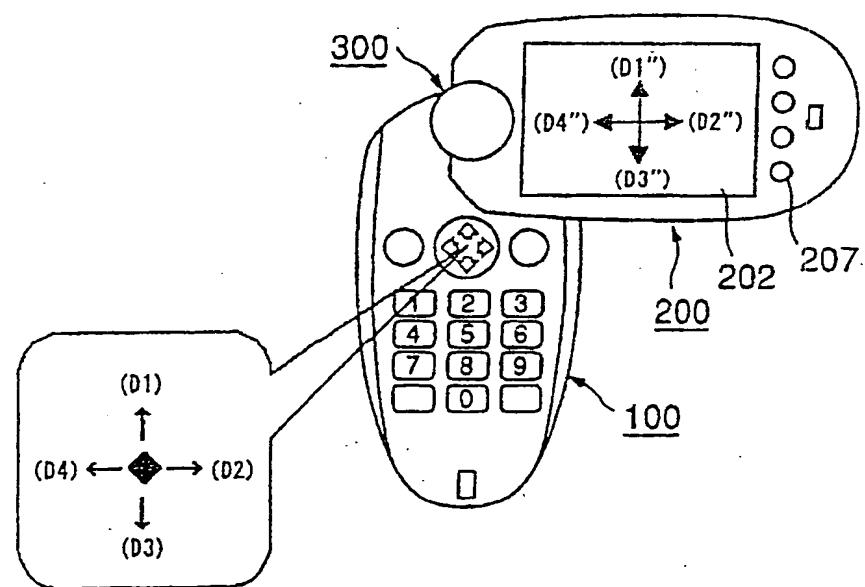


图 11B

Patent number: US2003064758

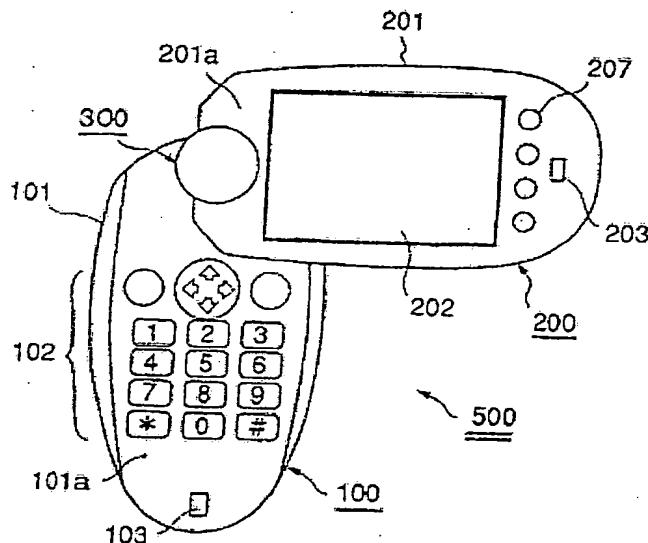
Applicant: NIPPON ELECTRIC CO (JP)

Publication date: 2003-04-03

Abstract of US2003064758

A foldable portable information terminal includes an upper unit having a display unit on its one side, a lower unit having operation keys on its one side, and a movable connecting mechanism connecting the upper unit and the lower unit allowing the upper unit to be opened, closed, and freely rotated with respect to a longitudinal direction of the lower unit. The displaying mode of the display unit whose direction varies depending on a position of the upper unit is changed depending on a positional relationship of the upper unit and the lower unit.

FIG.4A



Description of US2003064758

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a portable information terminal such as a portable telephone and a personal digital terminal, and in particular to a portable information terminal of a novel foldable structure that has an unprecedented function by further developing a foldable structure.

[0003] 2. Description of the Related Art

[0004] Conventionally, a straight type and a foldable type have been used for the structure of a portable information terminal, particularly a portable telephone. Among others, a portable telephone of a foldable structure type has been widely used and the demand for this has expanded because it can be accommodated in compact.

[0005] A typical example of the foldable portable telephone, as shown in FIG. 1, is provided with

a substantially oblong lower unit 100' disposed with an operation section 102' and an upper unit 200' of substantially the same shape having a rectangular display section 202', which are engaged together so as to be able to be freely opened and closed, by rotatably and axially connecting linear portions at respective one end of both units with a connection member 300' such that a operation section surface 101a faces a display unit fitting section 201a. In general, a display unit has a sufficient length in its longitudinal axis direction in order to take a large display area. Further, the directions of a operation section and display contents are determined with respect to a state where the operation section is positioned downward (frontward) at the open time.

[0006] A portable telephone has come to be utilized as a portable information terminal that has additional functions of a browser of the Internet, an e-mail transmission/reception terminal, and a schedule management, not only communications. Therefore, the display contents are wide including large quantity of character information and images, and increase in sizes of a display unit has been progressed.

[0007] According to the conventional portable telephone of a representative foldable structure, it is necessary to set both upper and lower units to an opened state without exception at the time of looking at a display or carrying out a certain operation. It is necessary to open and close it frequently, which is troublesome and leaves room for further improving the handling.

[0008] Further, according to the conventional portable telephone of a representative foldable structure, display contents are displayed to match a vertically long display surface. Therefore, at the time of reading displayed characters, the number of displayed characters in one lateral row is small, resulting in many returns and therefore it has been difficult to read. Further, at the time of displaying a horizontally oriented image, it has been necessary to convert the image into a smaller image, or see the whole image by a horizontal scroll operation. This has a drawback in that the easiness of handling is lost.

[0009] Further, as a result of securing the end linear portion and the connection member, only a limited design can be obtained by leaving the end linear portion in the external shape, resulting in a problem of a small degree of freedom on design.

[0010] In addition to the portable telephone, similar problems generally exist in a foldable apparatus, like a PDA (Personal Digital Assistant), for example, having a display unit and a operation section disposed separately in two units that are connected to be freely opened and closed in a similar manner.

[0011] Prior proposals that are individually related to the above problems will be explained briefly. A "foldable portable electronic apparatus" is disclosed in Japanese Patent Application Laid-open Publication No. 11-30226, which tries to solve the above-described problem of the portable telephone of a foldable structure that it is necessary to open the upper and lower units in order to look at the display or carry out an operation, and it is not easy to handle the apparatus.

[0012] FIGS. 2A-2C show a foldable portable telephone described in the above publication No. 11-30226. FIG. 2A is a perspective view in an opened state, FIG. 2B is a perspective view that shows a usual folded state, and FIG. 2C is a perspective view that shows a reversed folded state. In each view of FIGS. 2A-2C, reference numerals and symbols corresponding to those used in this publication are attached with a prime symbol "".

[0013] In FIGS. 2A-2C, in the foldable portable electronic apparatus, a pivot 6' that makes it

possible to reverse the front and back of a casing 2' at the display section is provided at a right angle to an axis portion 5a' of a hinge 5' that connects the casing 2' at the display section side with a casing 4' at the operation section side. With this arrangement, it is possible to fold the casing 2' at the display section side by reversing it to expose the display unit 1'. This publication also discloses a structure that the pivot 6' is provided with a rotation limiting mechanism that limits the rotation at a front and back reversing position, and a click stopping mechanism that holds a rotation limited state.

[0014] In addition to the above, Japanese Patent Application Laid-open Publication No. 11-215218 also discloses a "portable radio communication apparatus" that tries to solve a similar problem.

[0015] FIGS. 3A-3C show a portable radio communication apparatus described in the above publication No. 11-215218. FIG. 3A is a perspective view in a state that a casing at a display side is rotated in an opened state, FIG. 3B is a top plan view that shows a first posture that the apparatus is closed with the display set to the inside, and FIG. 3C is a top plan view that shows a second posture that the apparatus is closed with the display exposed to the outside. In each view of FIGS. 3A-3C, reference numerals and symbols corresponding to those used in this publication are attached with a prime symbol "'".

[0016] In this publication, a hinge section 5' structured with a ball joint, for example, is used to connect a second casing (a casing at a display section) 6' provided with a display 7' to a first casing 1' that forms a pair with the second casing so that they can be freely opened and closed and supported to rotate relatively in an opened state. With this arrangement, a portable radio communication apparatus 10' is allowed to be closed with the second casing 6' reversed.

[0017] In addition to the above, Japanese Patent Application Laid-open Publication No. 2000-353030 proposes an "open/close type portable information terminal" such as a portable telephone that makes it possible to look at a display or carry out a simple operation without setting the upper and lower units to an opened state. According to this open/close type portable information terminal, a display section casing having a display section and a operation section casing having a operation section are structured to be able to rotate freely by connecting respective one end of both casings with a rotation mechanism in a state that a display section surface faces the same direction as that of a operation section surface. Operation keys that make it possible to look at the display section in a closed state, and carry out an operation in a closed state are provided in the display section casing. With this arrangement, it is possible to carry out a simple operation in a closed state.

[0018] A technique for solving the other problem that it is difficult to read sentences is disclosed in Japanese Patent Application Laid-open Publication No. 2001-156893. This technique is designed as a communication display system to be provided with a display unit section that can rotate a liquid display unit from vertically oriented to horizontally oriented and vice versa, and a display switching section that changes over a display of the liquid display section from vertically oriented to horizontally oriented and vice versa in synchronization with the rotation of the display unit section.

[0019] According to this arrangement, a rotatable display unit section is fitted to a main body in the case of a bar-type portable telephone, and is fitted to an upper unit of a main body in the case of a foldable portable telephone. In both cases, the rotatable display unit section is axially supported rotatably in a plane parallel with a main body surface. In order to improve its

operability, this publication also proposes a structure that a operation button is provided on a main body of the communication apparatus that appears after the display unit section has been rotated from vertical orientation to horizontal orientation.

[0020] Further, Japanese Patent Application Laid-open Publication No. 7-202748 discloses a portable radio apparatus having a display section that does not rotate but having a casing simply divided into two flat casings which overlap each other and connected rotatably along a plane parallel to the flat surface thereof, allowing the casings to be folded when not used, resulting in improved portability.

[0021] Furthermore, Japanese Patent Application Laid-open Publication No. 5-211547 discloses a portable telephone also having a fixed display section, in which a casing having a transmitter is rotatably and axially supported relative to a main casing, and a connection surface of both casings is formed in a curve. With this arrangement, when opened, a receiver and the transmitter are in a distance and at an angle suitable for communications.

SUMMARY OF THE INVENTION

[0022] The present invention has been made to solve the above problems in the conventional portable telephone.

[0023] An object of the present invention is to provide a foldable portable information terminal that is a further improvement of the conventional foldable structure, to avoid the need of opening upper and lower units to see various displays and carry out corresponding operations, to display a large quantity of characters easy to read, and to improve display of various images, in a novel structure with improved operability compared to the conventional one.

[0024] According to the present invention, a foldable portable information terminal includes a first unit having a display section on its one side, a second unit having an operation section, and a movable connecting mechanism connecting the first unit and the second unit at one end thereof. The foldable portable information terminal is characterized in that the movable connecting mechanism allows the first unit to be opened, closed, and freely rotated with respect to a longitudinal direction of the second unit.

[0025] The movable connecting mechanism may be a biaxial hinge, which connects the first unit to the second unit so that the first unit is allowed to be opened and closed and rotated freely. The biaxial hinge include: a first rotation axis which is securely and rotatably provided on an operation surface of the second unit in vicinity of one end thereof, the first rotation axis protruding approximately vertically from the operation surface; and a second rotation axis which is orthogonal to the first rotation axis and is provided in vicinity of a front end of the first rotation axis to axially and rotatably support the first unit.

[0026] The movable connecting mechanism may be fixedly disposed at a position that is deviated from center of one end of the operation surface of the second unit. In this structure, a part of the operation section on the second unit is exposed in a state that the first unit and the second unit are closed with the display section facing out, wherein a predetermined function is allocated to each key included in the part of the operation section.

[0027] The foldable portable information terminal may further include: a first stopping mechanism for stopping the first unit and the second unit at a predetermined rotation position; and a second stopping mechanism for stopping the first unit and the second unit in a predetermined open and close state. In this structure, the foldable portable information terminal

may further include: a rotation energizing mechanism for energizing the first unit and the second unit from the vicinity of the predetermined rotation position to a stop state position; and an open and close energizing mechanism for energizing the first unit and the second unit from the vicinity of the predetermined open and close state position to a stop state position.

[0028] The foldable portable information terminal may further include: a first restricting means for restricting a range of rotation of the first unit with respect to the second unit within a predetermined rotation angle range; and a second restricting means for restricting the first unit and the second unit within a predetermined open and close angle range. In this structure, a rotation range of the first unit may be restricted within a rotation angle range from -180[deg.] to +180[deg.].

[0029] The first unit may further have a secondary display section on the other side thereof.

[0030] The foldable portable information terminal may further include a position detector for determining an open and closed state and a rotation positional relationship of the first unit and the second unit.

[0031] The position detector may include: a plurality of magnetic field generators which are each provided at predetermined positions within one of the first and second units; a plurality of magnetic field detectors which are each provided at predetermined positions within the other of the first and second units, corresponding to the magnetic field generators; and a position determining section for determining a position of the first unit based on a detection signal of the magnetic field detector, wherein the detection signal varies depending on a positional relationship between the first unit and the second unit.

[0032] The foldable portable information terminal may further include a display controller controlling the display section of an approximately rectangular shape such that a displaying mode of the display section is changed depending on a positional relationship between the first unit and the second unit.

[0033] The display controller may change a direction of displayed contents on the display section so that the direction of the displayed contents matches a longitudinal direction of the second unit independently of a longitudinal direction of the display section which is one of a parallel direction and an orthogonal direction with respect to the longitudinal direction of the second unit.

[0034] The display controller may change a direction of displayed contents on the display section so that the direction of the displayed contents matches a position of the second unit in a state that the first unit and the second unit are closed with the display section facing out.

[0035] The first unit may have a second operation section which faces out when the first unit and the second unit are closed with the display section facing out so that the second operation section be used to perform a menu operation, an image operation, and a call arrival operation while visually confirming displayed contents on the display section.

[0036] The second operation section may be a touch panel provided on the display surface of the display section. The foldable portable information terminal may further include a touch panel function controller for changing a touch panel function enabled area of the touch panel on the display surface depending on a positional relationship between the first unit and the second unit.

[0037] The second operation section may include at least one operation button provided on a side surface of the first unit.

[0038] In the foldable portable information terminal, a directional operation performed by using

the operation section may be changed depending on a positional relationship between the first unit and the second unit. A direction instructed by a direction indication key of the operation section may be changed depending on a positional relationship between the first unit and the second unit, which is one of an open state, a rotated state, and a closed state with the display section facing out.

[0039] The display section may be stopped displaying and/or backlighting in a state that the first unit and the second unit are closed with the display section facing in.

[0040] The foldable portable information terminal may further include: an alert device for generating an alert for at least a call arrival by using at least one of sound, vibration, light, and the display section; and an alert controller controlling the alert device such that, when the position detector detects that the first unit and the second unit are shifted to a normal conversation position in a state that the alert device is alerting for the call arrival, the alert controller stops the alert device alerting.

[0041] The foldable portable information terminal may further include a call arrival and termination controller controlling such that the foldable portable information terminal is made off-hook when the position detector detects that the first unit and the second unit are shifted to a normal conversation position at an occurrence of an incoming call, and on-hook when the position detector detects that the first unit and the second unit are shifted from the normal conversation position to another position after the call has been terminated.

[0042] As described above, the foldable portable information terminal can be folded and freely rotated with respect to a longitudinal direction of the second unit, so that it can be folded with the display section facing out. Therefore, without opening the terminal, the user can read a mail, look at a map or other image, or confirm a calling party on the display. Consequently, the user can immediately carry out the operation of receiving a call after judging the display contents in the closed state. When the terminal is folded with the display section facing out, it is possible to carry it in compact while looking at a map or the like on the screen, resulting in improved ease of use.

[0043] Since the first unit having the display section can be rotated in a display plane direction, it is possible to suitably display the contents of both vertically and horizontally orientations without increasing in size, that is, the same size as a conventional portable telephone.

[0044] A structure in which the connecting member occupies only at the center or in the vicinity of the center on the end section of the terminal increases the degree of freedom in designing, allowing the design of an unprecedented shape.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] FIG. 1 is a perspective view showing a typical example of a conventional portable telephone having a foldable structure;

[0046] FIG. 2A is a perspective view of another conventional portable telephone in an opened state;

[0047] FIG. 2B is a perspective view of the conventional portable telephone in a usual folded state;

[0048] FIG. 2C is a perspective view of the conventional portable telephone in a reverse folded state;

[0049] FIG. 3A is a perspective view of another conventional portable telephone in an opened state;

[0050] FIG. 3B is a top plan view of the conventional portable telephone in a closed posture;

[0051] FIG. 3C is a top plan view of the conventional portable telephone in an inversely closed posture;

[0052] FIG. 4A is a plan view of a portable telephone according to an embodiment of the present invention in a state that an upper unit is extended to a horizontal direction by facing the display surface outward;

[0053] FIG. 4B is a perspective view of the main structure of a biaxial hinge and its vicinity used in the embodiment;

[0054] FIG. 5A is a top plan view of the biaxial hinge as shown in FIG. 4B;

[0055] FIG. 5B is a front view of the biaxial hinge as shown in FIG. 4B;

[0056] FIG. 5C is a side view of the biaxial hinge as shown in FIG. 4B;

[0057] FIG. 5D is a bottom plan view of the biaxial hinge as shown in FIG. 4B;

[0058] FIG. 6 is a schematic block diagram showing an electric circuit of the portable telephone according to the embodiment;

[0059] FIGS. 7A and 7B are schematic views for explanation of the layout of magnetic sensors and magnets in the portable telephone according to the embodiment;

[0060] FIG. 8 is an explanatory view showing positions of magnets corresponding to Hall elements of a lower unit in respective ones of main rotation positions of an upper unit;

[0061] FIGS. 9A-9D are plan views each showing main stop positions (relative postures) of a lower unit and an upper unit in the portable telephone according to the embodiment;

[0062] FIGS. 10A and 10B are explanatory views that show display examples (images) of a display unit in the portable telephone according to the embodiment;

[0063] FIGS. 11A and 11B are plan views showing a relationship between a display and directions of operation keys at different stop positions (relative postures) between the lower unit and the upper unit in the portable telephone according to the embodiment;

[0064] FIGS. 12A-12D are plan views each showing main stop positions (relative postures) between the lower unit and the upper unit in a portable telephone according to a second embodiment;

[0065] FIGS. 13A-13D are plan views each showing main stop positions (relative postures) between the lower unit and the upper unit in a portable telephone according to a third embodiment;

[0066] FIG. 14A is a flowchart showing the control operation of a touch panel portion in the third embodiment; and

[0067] FIG. 14B is a correspondence table between a stop position of both upper and lower units and a touch panel function enabled area in the display section according to the third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0068] According to the present invention, in a portable information terminal such as a portable telephone having an upper unit and a lower unit such that a unit having a display section (hereinafter, an upper unit) and a unit having a operation section (hereinafter, a lower unit) are

connected to be able to be freely opened and closed, a movable connecting member (such as a biaxial hinge) that connects the upper unit and the lower unit to be able to be freely opened and closed and rotatable with each other is used as a movable connecting member (a hinge section) that connects both units to each other. With this arrangement, a structure is provided that the upper unit rotates freely in the plane surface direction and the longitudinal axis direction thereof around the hinge section.

[0069] Such a structure allows the terminal to be closed with the display section facing outside that is normally accommodated inside in the closed state, and the display section to be operated in a position of horizontal orientation, that would be vertically oriented in the opened state. As a result, the handling of the portable information terminal improves substantially as described in detail later. The movable connecting member may be provided at the center position of the end portion of the upper unit and the lower unit, or may be provided at a position deviated from the center position.

[0070] The present invention will be described in detail below based on preferred embodiments with reference to the drawings.

[0071] First Embodiment

[0072] FIG. 4A shows a state that the upper unit is extended to a horizontal orientation by facing the display surface outward. FIG. 4B shows a structure of the vicinity of a biaxial hinge (movable connecting member) 300 used in the present embodiment.

[0073] 1.1) Foldable Structure

[0074] As shown in FIG. 4A, a portable telephone 500 according to the first embodiment is composed mainly of three portions: a lower unit 100 that has a operation section; an upper unit 200 that has a display section; and the biaxial hinge 300 as a movable connecting member (a universal hinge section) that connects the lower unit 100 and the upper unit 200 allowing free rotation.

[0075] The lower unit 100 and the upper unit 200 have flat and oval shapes having predetermined thickness and the approximately same size. The lower unit 100 and the upper unit 200 are mechanically connected via the biaxial hinge 300, which will be described in detail later. The upper unit 200 can rotate freely relative to the lower unit 100 around the biaxial hinge. The lower unit 100 and the upper unit 200 are electrically connected by an appropriate connection means via the biaxial hinge section.

[0076] An external case 101 of the lower unit 100 accommodates various electronic circuits encircled with a broken line 100A of FIG. 6. Each of the circuits will be described later. An operation section is disposed on one surface (the operation surface) 101a of the lower unit 100 and is composed of a plurality of operation keys 102 to be used to perform functions of the portable telephone 500. Further, an opening section for a microphone 103 is disposed at the front end of the same operation surface.

[0077] As shown in FIG. 4B, a first rotation axis 301 to be described later is rotatably fixed in a direction approximately perpendicular to the operation surface at the end portion of the lower unit and the center position in a width direction thereof with a predetermined distance (a distance of approximately a half of the thickness of the upper unit) from the edge of the lower unit in the vicinity of the base of the operation surface.

[0078] An external case 201 of the upper unit 200 accommodates various electronic circuits encircled with a broken line 200A in FIG. 6. Each of the circuits will be described later. A display

unit 202 having approximately a rectangular shape is disposed in vertical orientation on one surface (a display surface) of the upper unit. A speaker 203 is disposed at the front end. A small secondary display unit 206 is provided on the surface opposite to the display surface 201a (not shown in this figure).

[0079] A second rotation axis 302 is rotatably fitted to a position at approximately the center in a thickness direction of the upper unit on the base (the connection side) of the upper unit. This second rotation axis 302 has its center rotatably connected to the end of the first rotation axis 301, and has brackets 303 and 303 fitted to both ends of the axis that extends to both sides. The brackets 303 and 303 are securely fixed to the upper unit 200 from the inside.

[0080] As explained above, the portable telephone 500 according to the embodiment has such a structure that the two upper and lower units 200 and 100 are connected together with the biaxial hinge 300 that is structured to include the two orthogonal rotation axes 301 and 302 that can rotate independently, at the respective bases of the units.

[0081] 1.2) Biaxial Hinge

[0082] Next, a detailed structure of the biaxial hinge 300 employed in the present embodiment will be further described with reference to each of FIG. 4B and FIGS. 5A-5D. This biaxial hinge 300 is structured to include a first rotation axis (hereinafter, a horizontal rotation axis) 301 made of metal that is accommodated within the lower unit 100, rotatably fixed to a base plate 304 made of metal, which is in turn fixed to the lower unit 100 from the inside, with its end protruding perpendicularly from the lower unit operation surface, and a second rotation axis (hereinafter, an open/close rotation axis) 302 made of metal that is horizontal (parallel with the lower unit), and pierces through the end portion of the horizontal rotation axis 301 at a right angle relative to the horizontal rotation axis 301, and is fixed rotatably.

[0083] The open/close rotation axis 302 has a coiled click plate spring 305 and a ring-shaped click plate 306 made of metal loosely and windingly engaged with each of axis portions extended to both sides thereof. A bracket 303 of an L-shaped metal plate is fixed to the front end of the extended axis portion at one end 303a thereof. The other end 303b of each bracket 303 is a fitting wing 303c that has its L-shaped leg bent at a right angle, which appears to extend horizontally in the drawing. The end of the horizontal rotation axis 301, the open/close rotation axis 302, and the brackets 303, 303 are accommodated in the upper unit 200. Fitting holes 303d provided on the fitting wing 303c are used to fix the brackets 303, 303 to the upper unit 200 from the inside.

[0084] The horizontal rotation axis 301 and the open/close rotation axis 302 can rotate independently within a limited range. In the present embodiment, a restricting means (a stopper) is provided in each rotation axis mechanism so that a horizontal direction rotation range of the horizontal rotation axis 301 is restricted between -180[deg.] and +180[deg.], and a rotation range of the open/close rotation axis 302 is restricted between 0[deg.] and 180[deg.]. A horizontal rotation axis restricting means (a stopper) restricts a horizontal rotation. The open and close rotation is restricted by butting a click mechanism against the external cases.

[0085] The horizontal rotation axis restricting means will be described. The base plate 304 is in approximately a rectangular shape, and one long side 304a is matched with a curve shape of a connection side end of the external case of the lower unit. A long guide hole 304c of a predetermined width and a predetermined length is formed at the center of the other long side with a constant distance from the other long side 304b of the base plate 304. The center portion

of the long side 304b corresponding to the long guide hole 304c is cut away by a constant width. Such a structure forms a guide bar 304d having a rectangular shape at its cross section in the long side 304b. A horizontal rotation angle restricting stopper piece 307 is wound around this guide bar 304d so as to be slidable within a predetermined distance. A stopping claw 307a (see FIG. 5D) is formed at the center of the lower side of the horizontal rotation angle restricting stopper piece 307 protruding towards the horizontal rotation axis 301 side.

[0086] On the other hand, a projection 301a that is engaged with the stopping claw 307a is fitted to a lower end of the horizontal rotation axis 301, and this rotates together with the horizontal rotation axis 301. When this projection 301a butts against the stopping claw 307a of the horizontal rotation angle restricting stopper piece 307 by the rotation of the rotation axis, a horizontal direction rotation range (a rotation angle) of the upper unit is restricted. In the present embodiment, the rotation angle is restricted to $\pm 180[\text{deg.}]$ (rotates by $180[\text{deg.}]$ in the clockwise direction and in the counterclockwise direction from a completely folded state). Therefore, it is structured such that the horizontal rotation angle restricting stopper piece 307 slides by the width of the projection 301a of the horizontal rotation axis stopper. Such an arrangement avoids the upper unit 200 excessively rotating by exceeding a folding position. It is preferable that a stopping mechanism is provided that holds the rotation angles with weak force corresponding to the normal communication position, the folding position, and intermediate positions between both positions (rotation angles $+90[\text{deg.}]$ and $-90[\text{deg.}]$).

[0087] The click mechanism will be described hereinafter. The click mechanism is a mechanism that generates a suction torque to an opened state and a closed state (a torque to suck to an open position and a close position near the open position and the close position), and generates a holding torque at these positions. The click mechanism of the present embodiment is structured by the click plate 306 having a click plate projection 306a, a bracket groove 308, and the click plate spring 305.

[0088] The click plate 306 has the click plate projection 306a extending to the bracket side (outwardly). Each of the brackets 303, 303 has the bracket groove 308 formed on its inside surface so as to be engaged with the click plate projection 306a when the bracket is at a predetermined rotation position. The bracket groove 308 is provided at positions (angles, for example, $160[\text{deg.}]$ and $180[\text{deg.}]$) at which a click is generated at the close position and open position.

[0089] The click plate spring 305 presses the click plate 306 against the bracket 303. This pressing force defines the click torque. In the drawing, it appears that the click plate spring 305 is separated from the click plate 306 because the drawing is partly omitted. However, actually; the spring 305 is mounted in a compressed state between the click plate 306 and the horizontal rotation axis 301 to energize the click plate 306 outwardly at all times. A click is generated when the click plate projection 306a drops into the bracket groove 308 at predetermined open and close positions. When the click plate projection 306a is not at a click generation position, an open and closed state (an extension angle) is held with weak force, based on frictional force between the click plate 306 and the bracket 303.

[0090] The upper unit and the lower unit can be electrically connected using a known method. For example, both units may be electrically connected by hollowing both the horizontal rotation axis and the open/close rotation axis and passing interconnection wires through the hollows. Alternatively, an FPC (flexible print circuit) may be used to connect both ends to the lower unit

and the upper unit in such a way that a film-shaped FPC is wound around both rotation axes. In this case, it is preferable that the FPC is wound around each rotation axis by at least one turn, in order to increase durability of the FPC.

[0091] In the above-described biaxial hinge, the open/close rotation axis is rotatable relative to the horizontal rotation axis. Alternatively, it is also possible to structure such that the open/close rotation axis and the horizontal rotation axis are firmly fixed, and a bracket is rotatably fixed to each of both ends of the horizontal axis. Such an arrangement can be used in exactly the same manner as the biaxial hinge, and it is possible to rotate the upper and lower two units 200 and 100 independently in the horizontal direction and the open and close direction. This biaxial hinge structure can provide a second rotation axis acting as the open/close rotation axis composed of the axis portion and the bracket constitute. Such a structure is also included in the concept of the biaxial hinge in the present invention.

[0092] 1.3) Electric Circuit

[0093] Next, an electric circuit of the portable telephone according to the present embodiment will be described.

[0094] As shown in FIG. 6, the portable telephone according to the present embodiment is structured to include an antenna 104, an RF circuit 105, a modem 106, a baseband processing circuit 107, a codec circuit 108, a control unit 109, a microphone 103, operation keys 102, a alert means 110, and three magnetic sensors 111a, 111b and 111c that detect a position of the upper unit (a posture relative to the lower unit). These functional sections are mounted within the lower unit 100. A means for detecting a position of the upper unit (a posture relative to the lower unit) is not restricted to the magnetic sensors (Hall elements). It is also possible to use a feed switch or a known mechanical switch, for example.

[0095] The control unit 109 includes a rotation angle detector 112 that decides a rotation angle of the upper unit 200 based on the output of each magnetic sensor 111, an open/close detector 113 that detects an open/close state including a front/back state, a display controller 114 that controls a direction of display contents so as to reflect outputs of the rotation angle detector 112 and the open/close detector 113, a call arrival and termination controller 115 that can carry out a call arrival control operation corresponding to the open/close and movement operation of the upper unit, and an alert controller 116 that can control a call arrival notification corresponding to the open/close and movement operation of the upper unit.

[0096] The RF circuit 105 has a receiving circuit, a transmitting circuit, and a frequency synthesizer, which are not shown. The operation keys 102 includes a transmission key, conversion keys for alphabet/Kana/Kanji/numeral, a power source on/off key, a cross key for cursor operation, and an end key.

[0097] Further, the portable telephone of the embodiment is structured to include a speaker 203, a magnet 204a corresponding to the magnetic sensors 111a and 111b, a magnet 204c corresponding to the magnetic sensor 111c, a display unit (a liquid crystal display: LCD) 202 that becomes a main screen, and a touch panel mechanism 205, a secondary display unit 206, and a secondary operation key 207, which are built in the surface of the display unit 202. These functional sections are mounted on the upper unit. The speaker 203 acts as a telephone receiver and also as an alert means 110.

[0098] These individual circuit parts that constitute the electric circuit may be conventional ones, and their detailed descriptions and functions will be omitted.

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[0099] In the portable telephone 500 according to the present embodiment having the two units connected with the biaxial hinge 300, the upper unit 200 can be opened and closed relative to the lower unit by rotating around the second rotation axis 302, and can rotate around the first rotation axis 301 relative to the lower unit 100. Therefore, although front and back surface direction of the upper unit 200 is limited to a direction parallel with the second rotation axis 302, the upper unit can pivot around the position of the first rotation axis to an arbitrary position on one surface side of the lower unit. Further, it is also possible to turn upside down on the same position. In other words, the lower unit 100 and the upper unit 200 can take various relative postures as demanded. At one of the predetermined stop positions, it is possible to hold a relative posture with the horizontal rotation axis restricting means and the click mechanism.

[0100] 1.4) Relative Position Detection

[0101] The magnetic sensors 111a, 111b and 111c and the magnets 204 cooperate to detect a relative position between the lower unit 100 and the upper unit 200. Installation positions of the magnetic sensors 111 and the magnets 204 will be described in detail.

[0102] As shown in FIG. 7A, three Hall elements (magnetic sensors) 111 are disposed inside the lower unit 100 with the sensitive sides of the sensors facing the operation surface side. The two Hall elements 111a and 111b are disposed on the circumference of a predetermined radius around the horizontal rotation axis 301 and on two radius lines that each form an angle of 45[deg.] with respect to a long axis of the lower unit to form a central angle of 90[deg.] in the drawing. The third Hall element 111c is disposed at a position shifting to one side in the front end of the lower unit.

[0103] On the other hand, as shown in FIG. 7B, the magnet 204a that has a semicircle shape and is magnetized in a thickness direction in the drawing is fitted along the circumference of the predetermined radius around the first rotation axis 301 inside the upper unit 200. Further, the magnet 204b is provided at a position corresponding to the Hall element 111c in the front end of the upper unit.

[0104] The magnetic sensors 111 may be disposed on the upper unit 200, and the magnets 204 may be disposed on the lower unit 100. It is essential that one of the magnetic sensor and the magnet forming a pair is disposed on the upper unit and the other is disposed on the lower unit. It is not always necessary to use a semicircle magnet, and separate magnets may be disposed at corresponding positions of the Hall elements 111a and 111b.

[0105] As shown in FIG. 8, Lo1 indicates a position of the magnet 204a and Lo4 indicates a position of the magnet 204b in the case where both units are folded with the display surface exposed to the outside. In this state, the respective Hall elements 111a, 111b, and 111c generate outputs and therefore a current state (position) of the upper unit can be determined based on the outputs from the rotation angle detector 112 and the open/close detector 113.

[0106] Lo2 indicates a position of the magnet 204a when rotated by 90[deg.] in a clockwise direction in the drawing. In this case, only the Hall element 111b generates an output and thereby a state (position) of the upper unit can be determined. Lo3 indicates a position of the magnet 204a when further rotated by 90[deg.] in the clockwise direction in the drawing (a normal communication position). In this case, no output is obtained from any one of the Hall elements. Therefore, it is possible to decide a state (position) of the upper unit.

[0107] When both units are folded with the display surface facing inside, the position of the magnet 204a also becomes Lo1 (the direction of the magnetic field becomes opposite in case

of FIG.8). However, since the position of the magnet 204c becomes Lo4' which does not coincide with the Hall element 111c, it is possible to determine that both units are in the folded state with the display surface facing inside. When the Hall element also detects a direction of the magnetic field of the magnet, it is possible to decide various kinds of position without providing the Hall element 111c and the magnet 204b, and it is possible to detect a finer difference in position.

[0108] 1.5) Positions of Upper and Lower Units

[0109] In the portable telephone according to the embodiment, the lower unit and the upper unit can take various mutual positions (relative postures) as demanded. Particularly, at stop positions as shown in FIGS. 9A-9D, it is possible to hold the relative position.

[0110] As shown in FIG. 9A, the portable telephone is folded as the conventional case, which is compact and convenient to carry. Further, the display surface is protected without being exposed to outside. The secondary display section 206 provides a minimum display for information.

[0111] FIG. 9B shows a state (a normal communication state) that the upper unit 200 is erected and extended from the state of FIG. 9A. In this state, confirmation of the display, various kinds of operation, and communications can be performed in a similar manner to that of the conventional portable telephone.

[0112] Next, FIG. 9C shows a state that the upper unit 200 is rotated by approximately 90 degrees in the clockwise direction from the state shown in FIG. 9B, for example, along a plane parallel with the operation surface 101a of the lower unit 100. At this time, the display section is horizontally oriented. The state of FIG. 9C is also obtained when the upper unit is rotated in the counterclockwise direction by sliding it from the folded state of FIG. 9D.

[0113] When the upper unit and the lower unit are in the positional relationship as shown in FIG. 9C, this positional relationship is detected by the above-described position detecting means, which causes the display controller 114 to convert the display contents to be displayed on the display unit 202 into a horizontally oriented display (the left and right direction of the display contents matches the long side direction of the display unit).

[0114] In the state as shown in FIG. 9C, it is easy to confirm a large quantity of character information and to look at the display of an image that is long in the horizontal direction because of a horizontally oriented display.

[0115] FIG. 10A shows a display example (an image) of the display unit 202 in a state that the horizontally oriented contents information is displayed on the horizontally oriented screen. As shown in FIG. 10A, the whole display image of the horizontally long contents is displayed on the horizontally oriented screen.

[0116] According to the apparatus of the present embodiment, the vertically oriented contents can be displayed as it is in the vertically oriented position of the display section as shown in FIGS. 9B and 9D, and further it is also possible to display the center portion of a horizontally oriented image together with additional information by a predetermined operation or setting.

[0117] FIG. 10B shows another display example of the display unit 202 that horizontally long contents information is displayed on the vertically oriented display screen as shown in FIGS. 9B and 9D.

[0118] In this vertically oriented displaying state, the left and right side portions of the contents are cut as shown in FIG. 10B. When the horizontally long contents information is displayed on

the vertically oriented screen, it is possible to display contents supplementary information (subtitle information relating to the contents) or other function (mail function or the like) in the upper and lower margins (a contents non-display portion, or a shaded area of the vertically oriented screen in FIG. 10B). Such a vertically oriented displaying mode allows a function change, for example, by turning off sound output and displaying subtitles, or allows concurrent use of a plurality of functions such that another function is performed while receiving vertically oriented contents information that is streaming.

[0119] 1.6) Direction Control

[0120] In the present embodiment, since both units can take the above-described various positions, the direction-included operation by a key such as a direction instructing key (cursor key) matches the display direction corresponding to each of the above-described various positions.

[0121] As shown in FIG. 11A, consider the case where the upper unit 200 is erected and extended from the closed state (normal communication position) and a menu or contents are displayed on the display unit 202 of the upper unit 200. In this case, a "direction key" in the operation keys 102 of the lower unit 100 is used to move a cursor or select a menu item. When the "direction key" corresponding to one of directions D1-D4 is depressed, a processing in a corresponding one of directions D1'-D4' is carried out on the display screen.

[0122] Subsequently, when the display unit 202 is rotated by 90 degrees from the state of FIG. 11A, a move direction by the operation key 102 (the direction key) is changed so as to match the top, bottom, left and right of the display unit 202 of the upper unit 200 as shown in FIG. 11B. In other words, when the "direction key" corresponding to one of the directions D1-D4 is depressed, the processing in a corresponding one of directions D1" to D4" that are different from the above directions (but coincide with operation directions of the "direction key") is carried out on the horizontally oriented display screen. In this manner, the operation instructed by an operation key is suitably changed depending on the changeover between vertical and horizontal orientations of the display unit.

[0123] As described above, according to the portable telephone of the embodiment, it is possible to look at the display by rotating the display unit to a desired direction in the opened state, and carry out a desired operation. Although not shown in the drawing, contrary to the above explanation, it is also possible to rotate the upper unit 200 in the counterclockwise direction in a display plane direction by approximately 90 degrees from a normal communication position (a standard extension state) as shown in FIG. 9B. In this state, the upper unit 200 and the lower unit 100 also become in an approximately orthogonal state within approximately the same plane, and the display unit becomes horizontally oriented with respect to the top and bottom directions of the operation surface.

[0124] In this case, such a positional relation of the upper unit and the lower unit can be detected by the above-described position detecting means, which causes the display controller 114 to convert the display contents to be displayed on the display unit 202 to a horizontally oriented display, that is, the left and right direction of the display contents matches the long side direction of the display unit, which is an opposite direction to the direction shown in FIG. 9C. Further, the processing instructed by a predetermined operation key is appropriately changed as described before.

[0125] In the portable telephone according to the embodiment, it is also possible to set the

upper and lower units to a closed state such that the display unit faces out, which is opposite to the usual state that the display unit is accommodated inside when closed. As shown in FIG. 9D, the upper unit 200 is folded to the lower unit 100 with the display surface of the upper unit 200 facing out. For example, when the upper unit 200 is rotated by a half turn from a state that the portable telephone is opened as shown in FIG. 9B, it is possible to close the upper and lower units in an opposite direction with the display surface exposed to the outside as shown in FIG. 9D. In this state, the portable telephone becomes compact and becomes convenient for carrying it. At the same time, it is possible to visually confirm the display contents in the folded state. Further, since the second operation section 207 is exposed to the outside, it is possible to carry out a desired operation in response to the display contents by using the second operation section 207.

[0126] Such a folded state as shown in FIG. 9D is detected by the above-described upper unit position detecting means, which causes the display contents on the display unit to turn upside down. In this case, the direction-included operation by a key such as a direction instructing key (cursor key) matches the display direction. With this arrangement, it is possible to read the displayed contents as they are and carry out a desired operation as in the usually folded state without changing the way the user holds the portable telephone in the hand.

[0127] 1.7) Operation

[0128] An operation of the portable telephone according to the embodiment will be described.

[0129] First, the operation of the portable telephone for transmitting and receiving a speech signal will be explained. The antenna 104 receives a radio signal from a base station, and transmits a radio signal. A radio signal received by the antenna 104 is output to a receiving circuit of the RF circuit 105. The receiving circuit selects a signal of a frequency indicated by a frequency synthesizer, and determines whether the selected signal includes a signal notifying of an incoming call to its own terminal (standby reception).

[0130] When the receiving circuit has detected a signal that notifies a call arrival to the own terminal, the receiving circuit notifies the call arrival to the control unit 109. The control unit 109 receives the notification from the receiving circuit that there is a call arrival to the own terminal, and drives the alert means 110 such as a beeper, a vibrator and/or a light-emitting diode to notify the user by sound, vibration and/or light blinking of the occurrence of an incoming call to the own terminal.

[0131] A user can set the portable telephone to a mode such that, when it is detected that the upper unit and the lower unit are opened in a normal communication position, the call arrival and termination controller 115 automatically sets the operation to an off-hook state to connect the telephone line. In this setting, the reception signal transmitted from a call originating terminal is output to the modem (modem) 106 via the RF circuit 105. At the same time, the call arrival and termination controller 115 stops the alert operation.

[0132] Then, the modem 106 demodulates the reception signal to produce a baseband reception signal and output it to the baseband processing circuit 107. The baseband processing circuit 107 processes the baseband reception signal and outputs it to the codec circuit 108. The codec circuit 108 decodes the baseband reception signal to output a sound signal to the speaker (telephone receiver) 203, which outputs sound waves. The codec circuit 108 also encodes a sound signal received by the microphone 103 to output a transmission signal to the baseband processing circuit 107 and the transmission signal is transmitted to the destination

through the modem 106 and the RF circuit 105. With this arrangement, the user can carry out communications immediately after the upper and lower units are opened.

[0133] When the above setting has not been done or when the upper unit and the lower unit have already been opened at the call arrival time, the telephone line is connected upon the off-hook operation of the user with a communication start key to allow communication.

[0134] When the user closes the upper unit and the lower unit to shift from the normal communication position to another after termination of the conversation, the unit position detector detects this position change, and the call arrival and termination controller automatically sets the operation state to the on-hook state (communication termination processing). Of course, the same communication termination can be made by the user operating a predetermined termination key for off-hook in the normal communication position.

[0135] 1.8) Transmission and Reception Operation

[0136] Next, the operation of transmitting and receiving character data or graphics data in this portable telephone will be described. The portable telephone monitors whether the selected signal includes a signal indicating transmission of character data to its own terminal (standby reception). When character data or graphics data has been received, the control unit 109 automatically receives the transmitted character data without waiting for the off-hook operation, and displays information in the display unit 202 based on the received data. At the same time, the alert controller 116 drives the alert means 110 such as a beeper or a vibrator in a predetermined fashion different from that at the occurrence of an incoming call to notify the user that character data or graphics data has been received.

[0137] In other words, a signal carrying character data received from the call originating terminal is output to the modem 106 via the RF circuit 105, and is demodulated by the modem 106. The demodulated signal enters the baseband processing circuit 107, which extracts character data from the demodulated signal, to output it to the control unit 109.

[0138] The control unit 109 includes the a CPU, a ROM storing programs, data necessary to process various kinds of processing, and character font data, a RAM used as a work area, a Video RAM to display information on the display unit 202, and the display controller 114 that controls the display unit 202 and/or the secondary display 206.

[0139] The display controller 114 forms character information or graphic information to be displayed on the display unit 202 (or the secondary display unit 206 if necessary) based on data received from the baseband processing circuit 107.

[0140] Further, the portable telephone can create message data and transmit it to a destination. In other words, alphabet letters and Katakana characters are allocated to dial operation keys such as 0 to 9, *, and # that are provided on the operation section 102, and these keys include a conversion key for alphabet/Kana/Kanji/numeral conversion. It is possible to input message data and transmit it to a destination designated by the user operating these dial operation keys and the conversion key.

[0141] Particularly, in this portable telephone, when character data or graphics data is transmitted or received, the display unit 202 can be rotated to set the display to be horizontally long or horizontally oriented, making it easy to read displayed information, compared with the case of a vertically oriented screen. When character data or graphics data has been received, it is possible to use the display unit 202 as a horizontally oriented display unit as shown in FIG. 9C if the user wishes. At this time, as described before, the display controller 114 displays the

display contents on the display unit 202 by converting the contents so as to match the direction of the horizontally oriented screen. The upper unit 202 may be fixed to be reversed left to right, which is opposite to that in FIG. 9C. At this time, the display controller 114 also displays the contents on the display unit 202 by converting the contents to match the direction of the horizontally oriented screen. Further, the processing instructed by a predetermined operation key is appropriately changed as described before.

[0142] Further, in this portable telephone, it is possible to transmit and receive character data or graphics data in the state that the upper unit and the lower unit are folded with the display unit 202 facing out. In other words, in the folded state with the display unit 202 facing out, the user can see the display unit 202 as it is. As the secondary operation keys 207 are also exposed to the external surface, when character data or graphics data has been received, it is possible to confirm the display instantly, and it is also possible to carry out a simple response operation in a state that the portable telephone is closed. At this time, when the display controller 114 displays the display contents on the display unit 202 by converting the contents to match the direction of the display screen that is reversed, the user can look at the display and carry out a response operation in the manner that the user is used to holding the terminal in the hand.

[0143] At the time of receiving desired image data, it is possible to make a request for the desired image data by setting the upper unit as shown in FIG. 9C. At the time of transmitting character data such as a message, it is possible to input characters in a position as shown in FIG. 9C, allowing easy input of characters in an easy-to-read display.

[0144] As described above, the portable telephone according to the present embodiment can provide the following advantages.

[0145] First, a conventional foldable portable telephone that is commercially available cannot see the main display without opening it. However, according to the present embodiment, the portable telephone can be folded with the display section facing out. Therefore, without opening the portable telephone, the user can read a mail, look at a map or other image, or confirm a calling party on the display. Consequently, the user can immediately carry out the operation of receiving a telephone call after judging the display contents in the closed state. When the portable telephone is folded with the display section facing out, it is possible to carry it in compact while looking at a map or the like on the screen. When the portable telephone is folded with the display section facing in as in the conventional case, it is possible to carry the portable telephone with protecting the display section. Further, by rotating the display unit to vertical orientation, it is possible to display the contents in a desired one of vertically oriented and horizontally oriented states with one portable telephone having the same size as the conventional one.

[0146] Second Embodiment

[0147] FIGS. 12A-12D show different positions of of a portable information terminal according to the second embodiment of the present invention. The portable telephone 500A according to the present embodiment is also composed mainly of three portions including a lower unit 100 that has an operation section, an upper unit 200 that has a display section, and a biaxial hinge 300' as a movable connecting member that connects the lower unit 100 and the upper unit 200 so as to be freely rotatable. The present embodiment is characterized in that the biaxial hinge (movable connecting member) 300' is located at a position deviated from the center position at the end of the upper unit and the lower unit. The other members and their structure are similar

to those of the first embodiment, and therefore, their descriptions will be omitted. In the drawings, members similar to those of the first embodiment are denoted by the same reference numerals or symbols.

[0148] FIG. 12A shows a state that the units are folded with the display surface of the upper unit 200 facing the lower unit 100. FIG. 12B shows a state (a normal communication state) that the upper unit 200 is erected and extended from the state of FIG. 12A. FIG. 12C shows a state that the upper unit 200 is rotated by approximately 90 degrees in the clockwise direction from the state shown in FIG. 12B, for example, along a plane parallel with the operation surface 101a of the lower unit 100. FIG. 12D shows a state that the upper unit 200 is folded to the lower unit 100 with the display surface of the upper unit 200 facing out.

[0149] As shown in FIGS. 12A-12D, the biaxial hinge (movable connecting member) 300' is located at a position deviated from the center position on the end of the upper unit and the lower unit. Therefore, particularly as shown in FIG. 12D, a part of operation keys 102, which is denoted by reference symbol 102b, is exposed in a state that the upper unit 200 is folded to the lower unit 100 with the display surface of the upper unit 200 facing out. In this state, the exposed part 102b of the operation keys 102 can be operated to which a predetermined key function is allocated. It is possible to suitably carry out a desired operation with the exposed part of the operation key 102a, thereby to improve the operability of the portable information terminal. In this structure, the secondary operation key 207 may be omitted.

[0150] Third Embodiment.

[0151] FIGS. 13A-13D show different positions of a portable information terminal according to a third embodiment of the present invention. A portable telephone 500B according to the present embodiment has a main structure similar to that of the first embodiment and therefore has similar appearance and mechanics. In the drawings, members similar to those of the first embodiment are denoted by the same reference numerals or symbols and their descriptions will be omitted. The present embodiment is characterized by control of a touch panel function.

[0152] FIG. 13A shows a state that the units are folded with the display surface of the upper unit 200 facing the lower unit 100. FIG. 13B shows a state (a normal communication state) that the upper unit 200 is erected and extended from the state of FIG. 13A. FIG. 13C shows a state that the upper unit 200 is rotated by approximately 90 degrees in the clockwise direction from the state shown in FIG. 13B, for example, along a plane parallel with the operation surface 101a of the lower unit 100. FIG. 13D shows a state that the upper unit 200 is folded to the lower unit 100 with the display surface of the upper unit 200 facing out. A shaded area of the display section 202 in each of FIGS. 13B-13D shows an example of a touch panel function enabled area 202t.

[0153] According to the present embodiment, the control unit 109 is further provided with a touch panel controller 208, which performs a touch panel control such that the touch panel function of the display unit 202 is made active or inactive. When the touch panel controller 208 has detected movement of open/close rotation of the upper unit 200 and the lower unit 100, the touch panel controller 208 changes a touch panel function enabled area 202t of the display unit 202 depending on which one of a plurality of positions of the upper unit 200 and the lower unit 100 is currently taken. In other words, the touch panel controller 208 switches each portion of the full screen of the display unit 202 between active and inactive depending on a position of the upper unit 200 and the lower unit 100, which is one of a plurality of predetermined stop positions.

[0154] An operation of the third embodiment will be described in detail below with reference to

FIGS. 14A and 14B.

[0155] As shown in FIG. 14B, the control unit 109 is provided with a memory (RAM) that previously stores the settings of a touch panel function enabled area 202t of the display unit 202, each settings corresponding to an opened state, a display horizontal-orientation state, and a closed state (display facing out) of the stop position between the upper unit 200 and the lower unit 100. In other words, in the opened state as shown in FIG. 13B, the shaded lower portion of the display section in the vertically oriented display state is set to a touch panel function enabled area 202t. In the horizontal-orientation state as shown in FIG. 13C, the shaded lower portion of the horizontally oriented display section is set to a touch panel function enabled area 202t. In the closed state with the display section facing out as shown in FIG. 13D, the full screen of the display section is set to a touch panel function enabled area 202t.

[0156] As shown in FIG. 14A, the control unit 109 monitors sensor outputs of the magnetic sensors to detect a current position of the upper and lower units: open, close or rotation positions (step S101). When the current position has been detected (YES at step S101), it is determined whether the detected position is a stop position (1.) (step S102). When it is the stop position (1.) (YES at step S102), a touch panel enabled area is changed to the lower portion in the vertically oriented display state (step S104). When it is not the stop position (1.) (NO at step S102), it is determined whether the detected position is a stop position (2.) (step S103). When it is the stop position (2.) (YES at step S103), a touch panel enabled area is changed to the lower portion in the horizontally oriented display state (step S105). When it is not the stop position (2.) (NO at step S103), a touch panel enabled area is set to the full screen of the display section (step S106).

[0157] As described above, according to the portable telephone of the present embodiment, the touch panel enabled area 202t of the display unit 202 is changed between the lower portion and the full screen of the display section depending on which one of the plurality of stop positions is detected. The enabled area may be expressed as a number of rows in a predetermined character size display, instead of a zone (area) of the display section. The settings stored in the memory (RAM) may be arbitrarily determined by a user.

[0158] The present invention has been explained with reference to the embodiments. However, the present invention is not limited to these embodiments, and it is also possible to implement the present invention in various modes. For example, the hinge section (movable connecting member) may be designed in a structure different from the above-described embodiments. It is essential that the connecting member can connect the upper unit to the lower unit so that the upper unit can be freely rotated, opened and closed to allow a desired relative position thereof as described above. Other members may be modified within the technical scope of the present invention.

[0159] For example, the display unit is not limited to an LCD, and may use an electro luminescent (EL). Further, operation buttons may be provided on the side surface of the upper unit as a secondary operation section. When the units are closed with the display unit facing in, the displaying and the backlighting (if it is a backlit LCD) preferably stop for energy saving.

[0160] Although the present invention has been explained taking a portable telephone as embodiments, the present invention is not limited to the portable telephone. It is also possible to apply the present invention to a portable information terminal such as a PDA, provided that the operation section and the display section are separated and foldable, which can achieve similar

operations and effects as described above.

[0161] The portable information terminal according to the present invention can provide the following advantages.

[0162] First, a conventional foldable portable telephone that is commercially available cannot see the main display without opening it. In contrast, according to the present embodiment, the portable telephone can be folded and freely rotated with respect to a longitudinal direction of the lower unit, so that it can be folded with the display section facing out. Therefore, without opening the portable telephone, the user can read a mail, look at a map or other image, or confirm a calling party on the display. Consequently, the user can immediately carry out the operation of receiving a telephone call after judging the display contents in the closed state. When the portable telephone is folded with the display section facing out, it is possible to carry it in compact while looking at a map or the like on the screen, resulting in improved ease of use.

[0163] Second, since the upper unit having the display section can be rotated in a display plane direction, it is possible to suitably display the contents of both vertically and horizontally orientations without increasing in size, that is, the same size as the conventional portable telephone.

[0164] Third, a structure in which the connection section occupies only the center portion increases the degree of freedom in designing, allowing the design of an unprecedented shape.

Claims of US2003064758

1. A foldable portable information terminal comprising:
a first unit having a display section on its one side;
a second unit having an operation section; and
a movable connecting mechanism connecting the first unit and the second unit at one end thereof, wherein the movable connecting mechanism allows the first unit to be opened, closed, and freely rotated with respect to a longitudinal direction of the second unit.
2. The foldable portable information terminal according to claim 1, wherein the movable connecting mechanism is a biaxial hinge which connects the first unit to the second unit so that the first unit is allowed to be opened and closed and rotated freely,
wherein the biaxial hinge comprises:
a first rotation axis which is securely and rotatably provided on an operation surface of the second unit in vicinity of one end thereof, the first rotation axis protruding approximately vertically from the operation surface; and
a second rotation axis which is orthogonal to the first rotation axis and is provided in vicinity of a front end of the first rotation axis to axially and rotatably support the first unit.
3. The foldable portable information terminal according to claim 1, wherein the movable connecting mechanism is fixedly disposed at a position that is deviated from center of one end of the operation surface of the second unit.
4. The foldable portable information terminal according to claim 1, further comprising:

a first stopping mechanism for stopping the first unit and the second unit at a predetermined rotation position; and
a second stopping mechanism for stopping the first unit and the second unit in a predetermined open and close state.

5. The foldable portable information terminal according to claim 4, further comprising:
a rotation energizing mechanism for energizing the first unit and the second unit from the vicinity of the predetermined rotation position to a stop state position; and
an open and close energizing mechanism for energizing the first unit and the second unit from the vicinity of the predetermined open and close state position to a stop state position.

6. The foldable portable information terminal according to claim 1, further comprising:
a first restricting means for restricting a range of rotation of the first unit with respect to the second unit within a predetermined rotation angle range; and
a second restricting means for restricting the first unit and the second unit within a predetermined open and close angle range.

7. The foldable portable information terminal according to claim 6, wherein a rotation range of the first unit is restricted within a rotation angle range from -180[deg.] to +180[deg.].

8. The foldable portable information terminal according to claim 1, wherein the first unit further has a secondary display section on the other side thereof.

9. The foldable portable information terminal according to claim 1, further comprising:
a position detector for determining an open and closed state and a rotation positional relationship of the first unit and the second unit.

10. The foldable portable information terminal according to claim 9, wherein the position detector comprises:
a plurality of magnetic field generators which are each provided at predetermined positions within one of the first and second units;
a plurality of magnetic field detectors which are each provided at predetermined positions within the other of the first and second units, corresponding to the magnetic field generators; and
a position determining section for determining a position of the first unit based on detection signals of the magnetic field detectors, wherein each detection signal varies depending on a positional relationship between the first unit and the second unit.

11. The foldable portable information terminal according to claim 9, further comprising:
a display controller controlling the display section of an approximately rectangular shape such that a displaying mode of the display section is changed depending on a positional relationship between the first unit and the second unit.

12. The foldable portable information terminal according to claim 11, wherein the display controller changes a direction of displayed contents on the display section so that the direction

of the displayed contents matches a longitudinal direction of the second unit independently of a longitudinal direction of the display section which is one of a parallel direction and an orthogonal direction with respect to the longitudinal direction of the second unit.

13. The foldable portable information terminal according to claim 11, wherein the display controller changes a direction of displayed contents on the display section so that the direction of the displayed contents matches a position of the second unit in a state that the first unit and the second unit are closed with the display section facing out.
14. The foldable portable information terminal according to claim 3, wherein a part of the operation section on the second unit is exposed in a state that the first unit and the second unit are closed with the display section facing out, wherein a predetermined function is allocated to each key included in the part of the operation section.
15. The foldable portable information terminal according to claim 1, wherein the first unit has a second operation section which faces out when the first unit and the second unit are closed with the display section facing out so that the second operation section be used to perform a menu operation, an image operation, and a call arrival operation while visually confirming displayed contents on the display section.
16. The foldable portable information terminal according to claim 15, wherein the second operation section is a touch panel provided on the display surface of the display section.
17. The foldable portable information terminal according to claim 15, wherein the second operation section comprises at least one operation button provided on a side surface of the first unit.
18. The foldable portable information terminal according to claim 1, wherein a directional operation performed by using the operation section is changed depending on a positional relationship between the first unit and the second unit.
19. The foldable portable information terminal according to claim 18, wherein a direction instructed by a direction indication key of the operation section is changed depending on a positional relationship between the first unit and the second unit, which is one of an open state, a rotated state, and a closed state with the display section facing out.
20. The foldable portable information terminal according to claim 16, further comprising: a touch panel function controller for changing a touch panel function enabled area of the touch panel on the display surface depending on a positional relationship between the first unit and the second unit.
21. The foldable portable information terminal according to claim 1, wherein the display section is stopped displaying and/or backlighting in a state that the first unit and the second unit are closed with the display section facing in.

22. The foldable portable information terminal according to claim 9, further comprising:
an alert device for generating an alert for at least a call arrival by using at least one of sound, vibration, light, and the display section; and
an alert controller controlling the alert device such that, when the position detector detects that the first unit and the second unit are shifted to a normal conversation position in a state that the alert device is alerting for the call arrival, the alert controller stops the alert device alerting.

23. The foldable portable information terminal according to claim 9, further comprising:
a call arrival and termination controller controlling such that the foldable portable information terminal is made off-hook when the position detector detects that the first unit and the second unit are shifted to a normal conversation position at an occurrence of an incoming call, and on-hook when the position detector detects that the first unit and the second unit are shifted from the normal conversation position to another position after the call has been terminated.